PATENT ABSTRACTS OF JAPAN

(11)Publication number : 11-309549
(43)Date of publication of application : 09.11.1999

(51)Int.Cl.	B22D 11/06 C22C 1/02 C22C 1/02 H01F 1/06

(21)Application number : 10-115187
(22)Date of filing : 24.04.1998

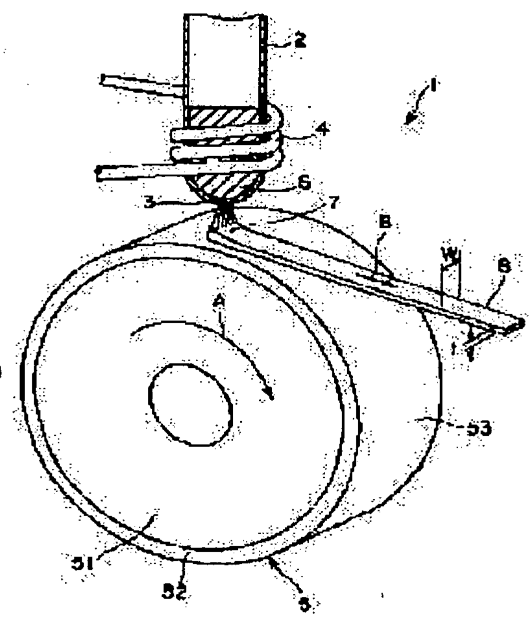
(71)Applicant : SEIKO EPSON CORP
(72)Inventor : ARAI SEI

(54) MANUFACTURE OF MAGNET MATERIAL, MAGNET MATERIAL AND BOND MAGNET

(57)Abstract:

PROBLEM TO BE SOLVED: To provide a manufacturing method of magnet material having high magnetic characteristic, a magnet material, and a bond magnet.

SOLUTION: A quenched strip manufacturing device 1 is provided with a cylindrical body 2, a heating coil 4, and a cooling roll 5 to be rotated relative to the cylindrical body 2. A nozzle 3 to eject molten metal 6 of a magnet material is formed on a lower end of the cylindrical body 2. In an atmospheric gas, the molten metal 6 is ejected from the nozzle 3, and collided with a circumferential surface 53 of the rotating cooling roll 5, and cooled and solidified to a quenched strip 8. A metallic material to constitute the circumferential surface 53 of the cooling roll 5 has wettability so that the contact angle formed on the horizontal surface of a solidified metal is 70-170° when a droplet of the molten metal 6 is placed and solidified on the horizontal surface of the metallic material.



LEGAL STATUS

[Date of request for examination]

[Date of sending the examiner's decision of rejection]

[Kind of final disposal of application other than the examiner's decision of rejection or application converted registration]

[Date of final disposal for application]

[Patent number]

[Date of registration]

[Number of appeal against examiner's decision of rejection]

[Date of requesting appeal against examiner's decision of rejection]

CLAIMS

[Claim(s)]

[Claim 1] Inject the molten metal of magnet material from a nozzle, make it collide with the peripheral surface of the cooling roller which is rotating to the aforementioned nozzle, and cooling solidification is carried out. The metallic material which is the manufacture method of magnet material of manufacturing a thin band-like magnet material, and constitutes the peripheral surface of the aforementioned cooling roller The manufacture method of the magnet material characterized by being that from which the contact angle with the aforementioned horizontal surface of the congelation to make becomes 70-170 degrees when the drop of the aforementioned molten metal is made to place and solidify on the horizontal surface of this metallic material.

[Claim 2] Inject the molten metal of magnet material from a nozzle in a controlled atmosphere, make it collide with the peripheral surface of the cooling roller which is rotating to the aforementioned nozzle, and cooling solidification is carried out. The metallic material which is the manufacture method of magnet material of manufacturing a thin band-like magnet material, and constitutes the peripheral surface of the aforementioned cooling roller The manufacture method of the magnet material characterized by being that from which the contact angle with the aforementioned horizontal surface of the congelation to make becomes 70-170 degrees when the drop of the aforementioned molten metal is made to place and solidify on the horizontal surface of the aforementioned metallic material in the aforementioned controlled atmosphere, a homotypic, and the gas of this **.

[Claim 3] The manufacture method of a magnet material according to claim 1 or 2 that the peripheral velocity of the aforementioned cooling roller is 1-60m/second.

[Claim 4] The manufacture method of a magnet material according to claim 1 to 3 that the maximum eccentricity of the cooling roller peripheral surface accompanying rotation of the aforementioned cooling roller is below the double precision of the average thickness of a thin band-like magnet material obtained.

[Claim 5] The aforementioned controlled atmosphere is the manufacture method of a magnet material according to claim 1 to 4 which is inert gas.

[Claim 6] The aforementioned magnet material is the manufacture method of a magnet material according to claim 1 to 5 which is an alloy containing R (however, at least one sort in the rare earth elements in which R contains Y).

[Claim 7] The aforementioned magnet material is the manufacture method of a magnet material according to claim 1 to 5 which is an alloy containing R (however, at least one sort in the rare earth elements in which R contains Y), and TM (however, TM, at least one sort in transition metals) and B.

[Claim 8] Thin band-like magnet material characterized by being manufactured by the manufacture method of a magnet material according to claim 1 to 7.

[Claim 9] Powdered magnet material characterized by having ground a magnet material according to claim 8, and supposing that it is powdered.

[Claim 10] The bond magnet which combines a powdered magnet material according to claim 9 by the joint resin, and is characterized by the bird clapper.

[Claim 11] The bond magnet according to claim 10 whose content of the magnet material of the shape of aforementioned powder is 82 - 99.5wt%.

[Claim 12] Coercive force iHc Bond magnet according to claim 10 or 11 which is 0.35 or more MA/m.

[Claim 13] Magnetic-energy product (BH) max 50 kJ/m3 Bond magnet according to claim 10 to 12 which it is above.

DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[The technical field to which invention belongs] this invention relates to the manufacture method, the magnet material, and the bond magnet of magnet material.

[0002]

[Description of the Prior Art] Since the rare earth permanent magnet material which consists of alloys containing rare earth elements as a magnet material has high magnetic properties, when used for a motor etc., it demonstrates high performance.

[0003] Such a magnet material is manufactured by the quenching method which used for example, the quenching thin band manufacturing installation. This manufacture method is as follows.

[0004] Fuse the magnet material (henceforth an "alloy") of predetermined alloy composition, inject the molten metal from a nozzle, and it is made to collide with the peripheral surface of the cooling roller which is rotating to a nozzle, and by making this peripheral surface contact, it quenches, an alloy is solidified and a thin band-like (ribbon base) alloy is formed continuously. This thin band-like alloy is called quenching thin band.

[0005] By the way, although the molten metal injected from the nozzle collides with the peripheral surface of a cooling roller, a paddle (cold slug well) is formed first, and it is cooled after that and solidified, if the cooling rate

is slow, crystal grain will turn big and rough and magnetic properties will fall.
[0006] Therefore, as a metallic material which constitutes the peripheral surface of a cooling roller, the material which is excellent in thermal conductivity was chosen.
[0007]
[Problem(s) to be Solved by the Invention] However, even when the metallic material excellent in thermal conductivity is used for the peripheral surface of a cooling roller in recent years, the problem that a low case has magnetic properties has arisen.
[0008] The purpose of this invention is to offer the manufacture method, the magnet material, and the bond magnet of the magnet material from which high magnetic properties are obtained.
[0009]
[Means for Solving the Problem] The volumetric flow rate Q of a quenching thin band (volume of the molten metal injected by per volume = unit time of the quenching thin band manufactured by per unit time) is expressed with the following formula (I) when it is made into the peripheral velocity V of the width of face w of a quenching thin band, thickness t, and a cooling roller.
[0010] Q=wxtxV ... (I)
On the other hand, since a paddle tends to spread more that the wettability (only henceforth "wettability of a roll peripheral surface") to the molten metal of the peripheral surface of a cooling roller is good in latus area on the peripheral surface of a cooling roller, the width of face w of a quenching thin band becomes large, and if the wettability of a roll peripheral surface is bad, the width of face w of a quenching thin band will become small conversely.
[0011] Therefore, when a quenching thin band is manufactured having set the peripheral velocity V of a cooling roller, and the volumetric flow rate Q of a quenching thin band as constant, when the wettability of the above-mentioned formula (I) to a roll peripheral surface is good, width of face w is large, a small quenching thin band is obtained for thickness t, and if the wettability of a roll peripheral surface is conversely bad, width of face w will be small, a large quenching thin band will be obtained for thickness t, and it will become things.
[0012] And if thickness t of a quenching thin band is small, although heat transfer of the thickness direction is made for a short time and is advantageous to detailed-izing of crystal grain If thickness t of a quenching thin band is large, the heat transfer nature of the thickness direction is bad, the difference of the cooling rate of the roll side (field of the side in contact with the peripheral surface of a cooling roller) of a quenching thin band and a free side (field of the side which does not contact the peripheral surface of a cooling roller) will become large, and crystal grain will especially big-and-rough-become easy to turn into a free side side.
[0013] Since it was such, as a result of inquiring wholeheartedly paying attention to the wettability of a roll peripheral surface, by using the cooling roller which made wettability of a roll peripheral surface the predetermined range, this invention person could attain detailed-ization of crystal grain, found out that outstanding magnetic properties were obtained, and resulted in this invention.
[0014] That is, this invention is as being shown in following the (1) - (13).
[0015] (1) Inject the molten metal of magnet material from a nozzle, make it collide with the peripheral surface of the cooling roller which is rotating to the aforementioned nozzle, and carry out cooling solidification. The metallic material which is the manufacture method of magnet material of manufacturing a thin band-like magnet material, and constitutes the peripheral surface of the aforementioned cooling roller The manufacture method of the magnet material characterized by being that from which the contact angle with the aforementioned horizontal surface of the congelation to make becomes 70-170 degrees when the drop of the aforementioned molten metal is made to place and solidify on the horizontal surface of this metallic material.
[0016] (2) Inject the molten metal of magnet material from a nozzle in a controlled atmosphere, make it collide with the peripheral surface of the cooling roller which is rotating to the aforementioned nozzle, and carry out cooling solidification. The metallic material which is the manufacture method of magnet material of manufacturing a thin band-like magnet material, and constitutes the peripheral surface of the aforementioned cooling roller The manufacture method of the magnet material characterized by being that from which the contact angle with the aforementioned horizontal surface of the congelation to make becomes 70-170 degrees when the drop of the aforementioned molten metal is made to place and solidify on the horizontal surface of the aforementioned metallic material in the aforementioned controlled atmosphere, a homotypic, and the gas of this **.
[0017] (3) The above (1) whose peripheral velocity of the aforementioned cooling roller is 1-60m/second, or the manufacture method of a magnet material given in (2).
[0018] (4) The above (1) whose maximum eccentricity of the cooling roller peripheral surface accompanying rotation of the aforementioned cooling roller is below the double precision of the average thickness of a thin band-like magnet material obtained, or the manufacture method of a magnet material given in either of (3).
[0019] (5) The aforementioned controlled atmosphere is the manufacture method of a magnet material the above (1) which is inert gas, or given in either of (4).
[0020] (6) The aforementioned magnet material is the manufacture method of a magnet material the above (1) which is an alloy containing R (however, at least one sort in the rare earth elements in which R contains Y), or given in either of (5).
[0021] (7) The aforementioned magnet material is the manufacture method of a magnet material the above (1)

which is an alloy containing R (however, at least one sort in the rare earth elements in which R contains Y), and TM (however, TM, at least one sort in transition metals) and B, or given in either of (5).
[0022] (8) Thin band-like magnet material characterized by being manufactured by the manufacture method of a magnet material the above (1) or given in either of (7).
[0023] (9) Powdered magnet material characterized by having ground the magnet material of a publication to the above (8), and supposing that it is powdered.
[0024] (10) The bond magnet which combines a powdered magnet material of a publication with the above (9) by the joint resin, and is characterized by the bird clapper.
[0025] (11) A bond magnet given in the above (10) whose content of the magnet material of the shape of aforementioned powder is 82 - 99.5wt%.
[0026] (12) Coercive force iHc The above (10) which is 0.35 or more MA/m, or bond magnet given in (11).
[0027] (13) Magnetic-energy product (BH) max 50 kJ/m3 The above (10) which it is above, or bond magnet given in either of (12).
[0028]
[Embodiments of the Invention] Hereafter, the manufacture method, the magnet material, and the bond magnet of the magnet material of this invention are explained in detail, referring to an accompanying drawing.
[0029] The perspective diagram showing the example of composition of the equipment (quenching thin band manufacturing installation) to which drawing 1 manufactures the magnet material of this invention by the single rolling method, and drawing 2 are the cross-section side elevations showing the state near the collision part to the cooling roller of the molten metal in the equipment shown in drawing 1 .
[0030] As shown in drawing 1 , the quenching thin band manufacturing installation 1 is equipped with the barrel 2 which can contain magnet material, and the cooling roller 5 which rotates in the direction of arrow in drawing A to this barrel 2. The nozzle (orifice) 3 which injects the molten metal of magnet material is formed in the soffit of a barrel 2.
[0031] Moreover, by arranging the coil 4 for heating at an about three nozzle [of a barrel 2] periphery, and impressing a RF to this coil 4, the inside of a barrel 2 is heated (IH) and the magnet material in a barrel 2 is changed into a melting state.
[0032] The cooling roller 5 consists of a base 51 and a surface layer 52 which forms the peripheral surface 53 of a cooling roller 5.
[0033] The component of a base 51 may consist of the quality of the materials which may really consist of the same quality of the materials as a surface layer 52, and are different in a surface layer 52.
[0034] Although especially the component of a base 51 is not limited, it is desirable to consist of metallic materials with high thermal conductivity like copper or a copper system alloy so that the heat of a surface layer 52 can be radiated more quickly.
[0035] Moreover, as for a surface layer 52, it is desirable to consist of metallic materials which are described below.
[0036] Such a quenching thin band manufacturing installation 1 is installed in a chamber (not shown), and operates in the state where it filled up with the controlled átmosphere of inert gas or others preferably in this chamber. In order to prevent oxidization of the quenching thin band 8 especially, as for a controlled atmosphere, it is desirable that it is inert gas.
[0037] As inert gas, although argon gas, gaseous helium, nitrogen gas, etc. are mentioned, for example, especially gaseous helium is desirable. the dimple according to the contamination of a gas stream to the roll side 81 of the quenching thin band 8 when gaseous helium is used for the reason as a controlled atmosphere, especially area -- the huge 2000-micrometer two or more dimples 13 (the imaginary line in drawing 2 shows) -- being generated -- being hard -- it is because heat transfer nature improves and higher magnetic properties are obtained
[0038] When magnet ingredients are paid in a barrel 2, and it heats with a coil 4, it fuses in the quenching thin band manufacturing installation 1 and the molten metal 6 is injected from a nozzle 3, as shown in drawing 2 , a molten metal 6 It is cooled quickly, and solidifies, being dragged by the peripheral surface 53 of the rotating cooling roller 5, after colliding with the peripheral surface 53 of a cooling roller 5 and forming a paddle (cold slug well) 7, and the quenching thin band 8 is formed continuously or intermittently. Thus, soon, the roll side 81 separates from a peripheral surface 53, and the formed quenching thin band 8 runs in the direction of arrow B in drawing 1 . In addition, a dotted line shows the solidification interface 71 of a molten metal among drawing 2 .
[0039] Although the suitable range changes with wettability to composition of an alloy molten metal, and the molten metal 6 of a peripheral surface 53 etc., usually, as for the peripheral velocity V of a cooling roller 5, it is desirable that it is 1-60m/second, and it is more desirable that it is 5-40m/second. If the peripheral velocity of a cooling roller 5 is too slow, thickness t of the quenching thin band 8 will become thick with the volumetric flow rate Q of the quenching thin band 8 (refer to the aforementioned formula (I)), the diameter of crystal grain will increase, if the peripheral velocity V of a cooling roller 5 is too quick conversely, it will become amorphous and, in any case, magnetic properties will fall.
[0040] The metallic material which constitutes the peripheral surface 53 of a cooling roller 5, i.e., the metallic material which constitutes a surface layer 52, (henceforth "roll peripheral surface material") has the wettability

(only henceforth "wettability") to the following molten metals 6, and it is constituted. That is, as shown in drawing 3 , a horizontal surface 10 is formed with the roll peripheral surface material 9, the drop of a molten metal 6 is placed on this horizontal surface 10, and when it is made to solidify, the contact angle theta with the horizontal surface 10 of the congelation 11 to make becomes 70-170 degrees. In this case, it is desirable that it is 80-165 degrees, as for a contact angle theta, it is more desirable that it is 90-160 degrees, and it is still more desirable that it is 95-150 degrees.

[0041] The wettability of the peripheral surface 53 of a cooling roller 5 is not measured directly, but a horizontal surface 10 is formed with the same material (roll peripheral surface material) as it here, and the wettability of this horizontal surface 10 is measured because it cannot stop and put the drop of a molten metal 6 on a fixed position but measurement of a contact angle is impossible or difficult for it, since a peripheral surface 53 is a curve convex.

[0042] In addition, in order to obtain more the correspondence relation with wettability of the peripheral surface 53 of the cooling roller 5 used for actual manufacture of a quenching thin band to accuracy on the occasion of measurement of a contact angle theta, it is desirable to perform solidification of the drop of a molten metal 6 in the aforementioned controlled atmosphere, a homotypic, and the gas of this **. Moreover, the volume of a congelation 11 is 3 0.005-0.1cm. Measuring in the range is desirable.

[0043] If a contact angle theta exceeds the upper limit of the above-mentioned range, the wettability of a peripheral surface 53 will be bad, and it will become the inclination for thickness t of the quenching thin band 8 to become thick with the volumetric flow rate Q of the quenching thin band 8, especially the crystal grain by the side of the free side 82 of the quenching thin band 8 will turn big and rough, and magnetic properties will fall. In addition, if a volumetric flow rate Q is made small also by this case, although thickness t also becomes thin (refer to the aforementioned formula (I)) and this fault is canceled or eased, since the fall of productivity is caused, it is not desirable.

[0044] Moreover, since the wettability of a peripheral surface 53 is too good in a contact angle theta being under the lower limit of the above-mentioned range, a paddle 7 spreads too much, therefore the configuration of the quenching thin band 8 and a size (width of face w, thickness t) become unstable, and the uniform and homogeneous quenching thin band 8 is not obtained (variation arises in a state, magnetic properties, etc. of crystal grain).

[0045] In addition, on the occasion of measurement of a contact angle theta, the exfoliation (coming floating) 12 as shown in drawing 4 may arise by the solidification shrinkage near the solidification interface the drop of a molten metal 6 contacts a horizontal surface 10. In this case, the portion which exfoliation 12 produced is excepted and a contact angle theta is measured. Namely, a contact angle theta is measured by using as datum level field 10' parallel to the horizontal surface 10 which passes along the upper limit (peak) of exfoliation 12.

[0046] By the way, in the quenching thin band manufacturing installation 1, a cooling roller 5 faces rotating, and as shown in drawing 5 , some eccentricity (axial deflection) arises from the dimensional accuracy (roundness) of cooling roller 5 the very thing, the installation precision over the bearing of a cooling roller 5, etc.

[0047] If this eccentricity is large, the front face and the solidification interface 71 of a melting alloy in a paddle 7 vibrate, change will arise in the size (width of face w, thickness t) of the obtained quenching thin band 8, or change will arise at the time when the roll side 81 of the quenching thin band 8 touches the peripheral surface 53 of a cooling roller 5. Furthermore, the incidence rate of the aforementioned huge dimple 13 also increases. Consequently, the cooling rate of the quenching thin band 8 etc. is changed, and variation arises in magnetic properties. And magnetic properties fall [the bond magnet using the magnet powder or it which were obtained from such a quenching thin band 8].

[0048] In order to prevent such a thing, it is desirable to make maximum eccentricity deltaR (to refer to drawing 5) of the peripheral surface 53 of the cooling roller 5 accompanying rotation of a cooling roller 5 below into the double precision of thickness (average) t of the quenching thin band 8 which can be obtained by this invention, considering as 1.5 or less times is more desirable, and considering as 1 or less time is still more desirable. Thereby, the magnetic properties of the obtained quenching thin band 8 can be made more into homogeneity. And the magnetic properties of the bond magnet manufactured from this can be raised. Especially in this invention, further excellent magnetic properties can be demonstrated according to the synergistic effect of specifying such maximum eccentricity deltaR and specifying the wettability of the peripheral surface 53 mentioned above.

[0049] Here, especially the lower limit of maximum eccentricity deltaR is the limitation of the precision of the bearing which supports the limitation of the process tolerance of the peripheral surface 53 of a cooling roller 5, and a cooling roller 5 although not limited to 0.1 micrometers. It can consider as a grade.

[0050] In addition, maximum eccentricity deltaR can be measured with precision sizer vessels, such as for example, a laser displacement gage, an electrostatic displacement gage, and a precision gage.

[0051] As a magnet material in this invention, it is R (however, R). The alloy containing at least one sort in the rare earth elements containing Y, especially R (however, R) Rare earth permanent magnet material like the alloy containing at least one sort in the rare earth elements containing Y, and TM (however, TM, at least one sort in transition metals) and B is mentioned, and the thing of composition of following [1] - [4] is desirable.

[0052] [1] What makes a fundamental component the rare earth elements which are mainly concerned with Sm, and the transition metals which are mainly concerned with Co (henceforth a Sm-Co system alloy).

[0053] [2] What makes a fundamental component the transition metals which are mainly concerned with R (however, at least one sort in the rare earth elements in which R contains Y), and Fe, and B (henceforth a R-Fe-B system alloy).
[0054] [3] What makes a fundamental component the rare earth elements which are mainly concerned with Sm, the transition metals which are mainly concerned with Fe, and the element between grids which is mainly concerned with N (henceforth an Sm-Fe-N system alloy).
[4] What makes a fundamental component transition metals, such as R (at least one sort however, among the rare earth elements in which R contains Y), and Fe, and has a magnetic phase on nano meter level (nano crystal magnet).
[0055] As a typical thing of a Sm-Co system alloy, SmCo5 and Sm2 TM17 (however, TM, transition metals) are mentioned.
[0056] As a typical thing of a R-Fe-B system alloy, a Nd-Fe-B system alloy, a Pr-Fe-B system alloy, a Nd-Pr-Fe-B system alloy, a Ce-Nd-Fe-B system alloy, a Ce-Pr-Nd-Fe-B system alloy, the thing that replaced a part of Fe in these by other transition metals, such as Co and nickel, are mentioned.
[0057] It is Sm2 Fe17N3 which nitrided and produced Sm2 Fe17 alloy as a typical thing of an Sm-Fe-N system alloy. It is mentioned.
[0058] as the aforementioned rare earth elements, Y, La, Ce, Pr, Nd, Pm, Sm, Eu, Gd, Tb, Dy, Ho, Er, Tm, Yb, Lu, and a misch metal mention -- having -- these -- one sort -- or two or more sorts can be included moreover, Fe, Co, nickel, etc. mention as the aforementioned transition metals -- having -- these -- one sort -- or two or more sorts can be included Moreover, in order to raise magnetic properties, in magnet material, B, aluminum, Cu, Ga Si, Ti, V, Ta, Zr, Nb, Mo, Hf, Ag, Zn, P, germanium, etc. can also be contained if needed.
[0059] The magnetic properties in which the quenching thin band (thin band-like magnet material) 8 of this invention obtained by the above manufacture methods turned minutely, consequently crystal grain was excellent are obtained.
[0060] Moreover, a powdered magnet material (magnet powder) of this invention is obtained by grinding such a quenching thin band 8.
[0061] Especially the method of pulverization is not limited, for example, can be performed using various pulverization equipments, such as a ball mill, a vibration mill, a jet mill, and a pin mill, and a shredding equipment. In this case, pulverization can also be performed in a non-oxidizing atmosphere like [under a vacuum or a reduced pressure state (for example, 1x10-1 - 1x10-6 Torr) or in inert gas, such as nitrogen gas argon gas, and gaseous helium,], in order to prevent oxidization.
[0062] A different thing only not only in the thing of the same composition which mixed the magnet powder of two or more sorts of composition is sufficient as such magnet powder. For example, what mixed at least two sorts in the thing of composition of aforementioned [1] - [4] is mentioned. In this case, it can have the advantage of each magnet powder to mix simulataneously, and more excellent magnetic properties can be obtained easily.
[0063] Moreover, in the case of the thing for manufacturing the bond magnet mentioned later, although not limited, especially the mean particle diameter of magnet powder is 0.5-60 micrometers. A grade is desirable and it is 1-40 micrometers. A grade is more desirable. moreover, in order to obtain the good moldability at the time of fabrication by a small amount of joint resin which is mentioned later, the particle size distribution of magnet powder is distributed to some extent -- ****'s (there is variation) -- it is desirable The rate of a hole of the obtained bond magnet can be reduced by this, the mechanical strength of a bond magnet can be raised more, and magnetic properties can be improved further.
[0064] In addition, the mean particle diameters may differ for every composition of different magnet powder case [powder] and mixed although the magnet powder of two or more sorts of composition was mixed. Moreover, what is necessary is to just be manufactured by the method of a different this invention which at least one sort in the magnet powder of two or more sorts of composition mentioned above the case in the end of such mixed powder.
[0065] When a bond magnet is manufactured using the above magnet powder, such magnet powder has good unity (wettability of a joint resin) with a joint resin, therefore this bond magnet has a high mechanical strength and it becomes the thing excellent in thermal stability (thermal resistance) and corrosion resistance. Therefore, the magnet powder concerned fits manufacture of a bond magnet.
[0066] In addition, the magnet powder (powdered magnet material) of this invention cannot be overemphasized by that you may be what it is not limited to what is used for manufacture of a bond magnet, for example, is used for manufacture of a sintered magnet.
[0067] Next, the bond magnet of this invention is explained.
[0068] The bond magnet of this invention comes to join the above-mentioned magnet powder together by the joint resin.
[0069] As a joint resin (binder), any of thermoplastics and thermosetting resin are sufficient.
[0070] As thermoplastics, for example A polyamide (example : nylon 6, Nylon 46, Nylon 66, Nylon 610, Nylon 612, Nylon 11, Nylon 12, Nylon 612, nylon 6 -66), Liquid crystal polymers, such as a thermoplastic polyimide and an aromatic polyester, a polyphenylene oxide, Polyolefines, such as polyphenylene sulfide, polyethylene, polypropylene, and an ethylene vinylacetate copolymer, A denaturation polyolefine, a polycarbonate, a polymethylmethacrylate, Polyester, such as a polyethylene terephthalate and a polybutylene terephthalate,

The copolymer which is mainly concerned with these, a blend object, a polymer alloy, etc. are mentioned, and a polyether, a polyether ether ketone, polyether imide, a polyacetal, etc. can mix and use 1 of sorts of these, and two sorts or more.

[0071] Also among these, especially the moldability is excellent, and since the mechanical strength is high, that which is mainly concerned with a liquid crystal polymer and polyphenylene sulfide from the point of a polyamide and heat-resistant improvement is desirable. Moreover, these thermoplastics is excellent also in kneading nature with magnet powder.

[0072] Such thermoplastics has the advantage that selection wide range like what thought the moldability as important, and the thing which thought thermal resistance and the mechanical strength as important is attained by the kind, copolymerization-ization, etc.

[0073] On the other hand, as thermosetting resin, various epoxy resins, such as a bisphenol type, a novolak type and a naphthalene system, phenol resin, a urea resin, melamine resin, a polyester (unsaturated polyester) resin polyimide resin, silicone resin, a polyurethane resin, etc. are mentioned, and 1 of sorts of these and two sorts or more can be mixed and used, for example.

[0074] From the point of especially the moldability being excellent also among these, and a mechanical strength being high and excelling in thermal resistance, an epoxy resin, phenol resin, polyimide resin, and silicone resin are desirable, and especially an epoxy resin is desirable. Moreover, these thermosetting resin is excellent also in kneading nature with magnet powder, and the homogeneity of kneading.

[0075] In addition, the thing of a solid [thing / liquefied] (powdered) is sufficient as the thermosetting resin (un-hardening) used at a room temperature.

[0076] Such a bond magnet of this invention is manufactured as follows, for example. Magnet powder, a joint resin, and the constituent for bond magnets (compound) that contains additives (an antioxidant, lubricant, etc.) if needed are manufactured, and it fabricates in a desired magnet configuration all over a magnetic field or a non-magnetic field by methods, such as compression molding, extrusion molding, and injection molding, using this constituent for bond magnets. When a joint resin is thermosetting resin, it is hardened by heating etc. after fabrication.

[0077] As for the content of the magnet powder in a bond magnet, it is desirable that it is about 82-99.5wt%, and it is more desirable that it is about 90-99wt%. Although the bond magnet was especially manufactured by compression molding, as for the content of magnet powder, to a case, it is desirable that it is about 93-99.5wt%, and it is more desirable to it that it is about 95-99wt%.

[0078] If improvement in magnetic properties (especially magnetic-energy product) cannot be aimed at if there are too few contents of magnet powder, and there are too many contents of magnet powder, joint resins content will decrease relatively and a moldability will fall.

[0079] Such a bond magnet of this invention demonstrates outstanding magnetic properties from the property of the quenching thin band 8 used as the raw material mentioned above, the numerousness of the manufacture conditions of a bond magnet, and the contents of the magnet powder contained in a bond magnet, etc.

[0080] That is, the bond magnet of this invention is coercive force iHc. 0.35 or more MA/m is 0.50 or more MA/m more preferably.

[0081] The bond magnet of this invention, especially the bond magnet fabricated all over the non-magnetic field are magnetic-energy (product BH) max. It is 50 kJ/m3 preferably. It is 70 kJ/m3 more preferably above. It is above.

[0082] It is not limited, for example, about a configuration, the thing of all configurations, such as the shape of the shape of a pillar, a prismatic, and a cylinder (the shape of a ring), circular, plate-like, and a curve tabular, is possible for the configuration of the bond magnet of this invention, especially a size, etc., for example, and the thing of all sizes is possible for them from a thing also with the large-sized size to a micro thing.

[0083]

[Example] Hereafter, the concrete example of this invention is explained.

[0084] (Example 1) The hardener ingot as which alloy composition is expressed in Nd10Pr2.5 Febal.Co6 aluminum3 Cu1.5 Nb1 Ga1 B5 (composition A) was cast. About 15g sample was started from this ingot.

[0085] The quenching thin band manufacturing installation 1 of composition of being shown in drawing 1 was prepared, and the aforementioned sample was put in in the quartz tube which prepared the nozzle (circular hole orifice) in the bottom. After deaerating the inside of the chamber by which the quenching thin band manufacturing installation 1 is contained, gaseous helium was introduced as a controlled atmosphere and it considered as the temperature of 21 degrees C, and the controlled atmosphere of pressure 60KPa.

[0086] Then, the ingot sample in a quartz tube was fused by high-frequency induction heating, this molten metal was injected by the differential pressure of the internal pressure of a quartz tube, and an ambient pressure towards the peripheral surface of the cooling roller with a diameter [of 200mm], and a width of face of 20mm which rotates by 1500rpm (peripheral velocity : 15.7m/(second)), and the quenching thin band of the alloy of the aforementioned composition A was obtained.

[0087] The surface layer (roll peripheral surface) of a cooling roller should consist of Pd-8wt%Ru-2wt%Pt alloys. Moreover, thickness of this surface layer was set to 5mm.

[0088] It was 95 degrees when the contact angle theta of the aforementioned congelation was measured by the method which forms a horizontal surface with the component and this material of this surface layer, trickles

the molten metal of the aforementioned composition A calmly, is made to solidify it on the aforementioned horizontal surface in the gas of the aforementioned controlled atmosphere and these conditions, obtains a congelation (volume 0.01cm3), and is shown in drawing 3 or drawing 4 . In addition, measurement of a contact angle theta was optically performed using the projector.
[0089] moreover, the place which measured maximum eccentricity deltaR of the cooling roller peripheral surface by rotation of a cooling roller by the laser displacement gage -- deltaR=10micrometer it was .
[0090] (Example 2) The quenching thin band was manufactured like the example 1 except having constituted the surface layer (roll peripheral surface) of a cooling roller from a nickel-10wt%Ti-10wt%aluminum-5wt%Mo alloy.
[0091] It was 150 degrees, when the horizontal surface was formed with the component and this material of this surface layer, the molten metal of the aforementioned composition A is dropped calmly, was made to solidify on the aforementioned horizontal surface in the gas of the aforementioned controlled atmosphere and these conditions, the congelation (volume 0.01cm3) was obtained and the contact angle theta of the aforementioned congelation was measured by the same method as an example 1.
[0092] moreover, the place which measured maximum eccentricity deltaR of the cooling roller peripheral surface by rotation of a cooling roller by the laser displacement gage -- deltaR=12micrometer it was .
[0093] (Example 3) While manufacturing a quenching thin band from the molten metal of this composition which used the ingot which consists of Nd11Ce2 Sm1 Febal.Co4 Cu1.5 Ga1 Ti0.5 B6 (composition B) The quenching thin band was manufactured like the example 1 except having constituted the surface layer (roll peripheral surface) of a cooling roller from a W-20wt%Zr-3wt%Nb alloy.
[0094] It was 70 degrees, when the horizontal surface was formed with the component and this material of this surface layer, the molten metal of the aforementioned composition B is dropped calmly, was made to solidify on the aforementioned horizontal surface in the gas of the aforementioned controlled atmosphere and these conditions, the congelation (volume 0.01cm3) was obtained and the contact angle theta of the aforementioned congelation was measured by the same method as an example 1.
[0095] moreover, the place which measured maximum eccentricity deltaR of the cooling roller peripheral surface by rotation of a cooling roller by the laser displacement gage -- deltaR=9micrometer it was .
[0096] About each quenching thin band of the <characterization of quenching thin band> examples 1-3, the width of face w and thickness t were measured. This measurement was measured by 20 point of measurement per quenching thin band by the microscope, and was made into the value which averaged this, respectively.
[0097] Next, while measuring the diameter of average crystal grain from the organization observation result by transverse electromagnetic about each quenching thin band, magnetic properties (coercive force iHc and magnetic-energy (product BH) max) were measured by VSM.
[0098] These measurement results are shown in the following table 1.
[0099] In addition, there was very little variation by the measurement part (less than **5% of averages), and each size (width of face w, thickness t) of each quenching thin band had high dimensional stability.
[0100] Moreover, when the rate of area which observes a roll side with a scanning electron microscope (SEM), and performs image analysis further about each quenching thin band, and the with a 2000-micrometer area [or more 2] huge dimple to a roll side occupies from this analysis result was investigated, all were very low values.
[0101]
[Table 1]

急冷薄帯の特性

	接触角 θ	急冷薄帯の幅w (mm)	急冷薄帯の厚さt (μm)	平均結晶粒径 (nm)	iHc (MA/m)	(BH) max (kJ/m³)
実施例1	95°	1.1	26.7	25	0.69	112
実施例2	150°	0.8	30.9	29	0.64	104
実施例3	70°	1.4	24.5	23	0.95	92

[0102] As shown in Table 1, each quenching thin band of this invention of examples 1-3 can attain detailed-ization of crystal grain, and high magnetic properties are obtained.
[0103] (Example 4) A grinder (RAIKAI machine) grinds the quenching thin band of an example 1 in inert gas, and a mean particle diameter is 16 micrometers. It considered as magnet powder, this magnet powder, epoxy resin 2.0wt%, hydrazine system antioxidant 0.15wt%, and stearate (lubricant) 0.05wt% were mixed, this mixture was fully kneaded (120 degree-Cx 10 minutes), and the constituent for bond magnets (compound) was

produced.
[0104] subsequently -- grinding this compound and being granular -- carrying out -- this granular object -- weighing capacity -- carrying out -- the metal mold of press equipment -- inside -- being filled up -- 130 degrees C of material temperature, and pressure 6 ton/cm2 It pressed (inside of a non-magnetic field), and the Plastic solid was obtained. Heat hardening of the epoxy resin was carried out after mold release, and the pillar-like bond magnet with a diameter [of 10mm] x height of 7mm was obtained.
[0105] (Example 5) A grinder (RAIKAI machine) grinds the quenching thin band of an example 2 in inert gas, and a mean particle diameter is 20 micrometers. It considered as magnet powder, this magnet powder, epoxy resin 2.5wt%, hydrazine system antioxidant 0.1wt%, and stearate (lubricant) 0.1wt% were mixed, this mixture was fully kneaded (120 degree-Cx 10 minutes), and the constituent for bond magnets (compound) was produced
[0106] subsequently -- grinding this compound and being granular -- carrying out -- this granular object -- weighing capacity -- carrying out -- the metal mold of press equipment -- inside -- being filled up -- 130 degrees C of material temperature, and pressure 6 ton/cm2 It pressed (inside of a non-magnetic field), and the Plastic solid was obtained. Heat hardening of the epoxy resin was carried out after mold release, and the pillar-like bond magnet with a diameter [of 10mm] x height of 7mm was obtained.
[0107] (Example 6) A grinder (RAIKAI machine) grinds the quenching thin band of an example 3 in inert gas, and a mean particle diameter is 18 micrometers. It considered as magnet powder, this magnet powder, epoxy resin 1.9wt%, hydrazine system antioxidant 0.1wt%, and stearate (lubricant) 0.05wt% were mixed, this mixture was fully kneaded (120 degree-Cx 10 minutes), and the constituent for bond magnets (compound) was produced.
[0108] subsequently -- grinding this compound and being granular -- carrying out -- this granular object -- weighing capacity -- carrying out -- the metal mold of press equipment -- inside -- being filled up -- 130 degrees C of material temperature, and pressure 6 ton/cm2 It pressed (inside of a non-magnetic field), and the Plastic solid was obtained. Heat hardening of the epoxy resin was carried out after mold release, and the pillar-like bond magnet with a diameter [of 10mm] x height of 7mm was obtained.
[0109] (Example 7) The magnet powder obtained in the example 4 and the magnet powder obtained in the example 6 were uniformly mixed by the weight ratio 6:4, and mixed magnet powder was obtained. This mixed magnet powder, epoxy resin 2.0wt%, hydrazine system antioxidant 0.15wt%, and stearate (lubricant) 0.05wt% were mixed, this mixture was fully kneaded (120 degree-Cx 10 minutes), and the constituent for bond magnets (compound) was produced.
[0110] subsequently -- grinding this compound and being granular -- carrying out -- this granular object -- weighing capacity -- carrying out -- the metal mold of press equipment -- inside -- being filled up -- 130 degrees C of material temperature, and pressure 6 ton/cm2 It pressed (inside of a non-magnetic field), and the Plastic solid was obtained. Heat hardening of the epoxy resin was carried out after mold release, and the pillar-like bond magnet with a diameter [of 10mm] x height of 7mm was obtained.
[0111] (Example 8) The magnet powder obtained in the example 4, the magnet powder obtained in the example 5, and the magnet powder obtained in the example 6 were uniformly mixed by the weight ratio 2:3:5, and mixed magnet powder was obtained. This mixed magnet powder, epoxy resin 1.8wt%, hydrazine system antioxidant 0.2wt%, and stearin acid (lubricant) 0.1wt% were mixed, this mixture was fully kneaded (120 degree-Cx 10 minutes), and the constituent for bond magnets (compound) was produced.
[0112] subsequently -- grinding this compound and being granular -- carrying out -- this granular object -- weighing capacity -- carrying out -- the metal mold of press equipment -- inside -- being filled up -- 130 degrees C of material temperature, and pressure 6 ton/cm2 It pressed (inside of a non-magnetic field), and the Plastic solid was obtained. Heat hardening of the epoxy resin was carried out after mold release, and the pillar-like bond magnet with a diameter [of 10mm] x height of 7mm was obtained.
[0113] About each bond magnet of the <characterization of bond magnet> examples 4-8, the magnetic properties (coercive force iHc and magnetic-energy (product BH) max) were measured in maximum impression magnetic field 2 MA/m with the account fluxmeter of ******.
[0114] furthermore -- these bond magnets -- 60 degree-Cx95%RH -- the constant temperature by 500 hours -- the constant humidity examination was performed and corrosion resistance was investigated This corrosion resistance distinguished the existence of generating of the rust in a bond magnet front face by viewing, and evaluated as a x mark what ** mark and generating of rust were notably accepted in in what O mark and generating of rust were accepted in a little in the thing without generating of rust.
[0115] These measurement results are shown in the following table 2. Moreover, the content (in the case of mixed magnet powder, it is the total amount) of the magnet powder in each bond magnet is collectively described all over the following table 2.
[0116]
[Table 2]

ボンド磁石の特性

	用いた磁石粉末	ボンド磁石中の磁石粉末含有量 (wt%)	iHc (MA/m)	(BH) max (kJ/m³)	耐食性
実施例4	実施例1	97.9	0.67	73.5	○
実施例5	実施例2	97.4	0.62	70.6	△~○
実施例6	実施例3	98.0	0.94	62.9	○
実施例7	実施例1、3の混合 (=6:4)	97.9	0.84	70.4	○
実施例8	実施例1、2、3の混合 (=2:3:5)	98.1	0.90	68.5	○

[0117] As shown in Table 2, each bond magnet of this invention of examples 4-8 is more than coercive force iHc 0.35 MA/m and magnetic-energy (product BH) max. 50 kJ/m3 Corrosion resistance is also excellent while having the magnetic properties which were excellent with the above.
[0118] Especially, more excellent magnetic properties are obtained in the examples 7 and 8 using mixed magnet powder.
[0119]
[Effect of the Invention] Cooling of a molten metal is made good by using the cooling roller of a peripheral surface which was described above and which has moderate wettability like according to this invention. Therefore, big and rough-ization of crystal grain is prevented, and the obtained quenching thin band has high magnetic properties.
[0120] Especially, the difference of the diameter of crystal grain of the roll side of a quenching thin band and a free side can be made small, and equalization of magnetic properties can be attained. Therefore, the permanent magnet which has magnetic properties and corrosion resistance excellent in the high mechanical strength can be offered.
[0121] Moreover, by making small the maximum eccentricity of a cooling roller peripheral surface, the variation in the magnetic properties of a quenching thin band can be prevented effectively, and a permanent magnet with more excellent magnetic properties can be offered.
[0122] Moreover, in this invention, such a magnet can be manufactured easily, and productivity is also high.

TECHNICAL FIELD

[The technical field to which invention belongs] this invention relates to the manufacture method, the magnet material, and the bond magnet of magnet material.

PRIOR ART

[Description of the Prior Art] Since the rare earth permanent magnet material which consists of alloys containing rare earth elements as a magnet material has high magnetic properties, when used for a motor etc., it demonstrates high performance.
[0003] Such a magnet material is manufactured by the quenching method which used for example, the quenching thin band manufacturing installation. This manufacture method is as follows.
[0004] Fuse the magnet material (henceforth an "alloy") of predetermined alloy composition, inject the molten metal from a nozzle, and it is made to collide with the peripheral surface of the cooling roller which is rotating to a nozzle, and by making this peripheral surface contact, it quenches, an alloy is solidified and a thin band-like (ribbon base) alloy is formed continuously. This thin band-like alloy is called quenching thin band.
[0005] By the way, although the molten metal injected from the nozzle collides with the peripheral surface of a cooling roller, a paddle (cold slug well) is formed first, and it is cooled after that and solidified, if the cooling rate is slow, crystal grain will turn big and rough and magnetic properties will fall.
[0006] Therefore, as a metallic material which constitutes the peripheral surface of a cooling roller, the material which is excellent in thermal conductivity was chosen.

EFFECT OF THE INVENTION

[Effect of the Invention] Cooling of a molten metal is made good by using the cooling roller of a peripheral surface which was described above and which has moderate wettability like according to this invention. Therefore, big and rough-ization of crystal grain is prevented, and the obtained quenching thin band has high magnetic properties.
[0120] Especially, the difference of the diameter of crystal grain of the roll side of a quenching thin band and a free side can be made small, and equalization of magnetic properties can be attained. Therefore, the permanent magnet which has magnetic properties and corrosion resistance excellent in the high mechanical strength can be offered.
[0121] Moreover, by making small the maximum eccentricity of a cooling roller peripheral surface, the variation in the magnetic properties of a quenching thin band can be prevented effectively, and a permanent magnet with more excellent magnetic properties can be offered.
[0122] Moreover, in this invention, such a magnet can be manufactured easily, and productivity is also high.

TECHNICAL PROBLEM

[Problem(s) to be Solved by the Invention] However, even when the metallic material excellent in thermal conductivity is used for the peripheral surface of a cooling roller in recent years, the problem that magnetic properties may be low has arisen.
[0008] The purpose of this invention is to offer the manufacture method, the magnet material, and the bond magnet of the magnet material from which high magnetic properties are obtained.

MEANS

[Means for Solving the Problem] The volumetric flow rate Q of a quenching thin band (volume of the molten metal injected by per volume = unit time of the quenching thin band manufactured by per unit time) is expressed with the following formula (I) when it is made into the peripheral velocity V of the width of face w of a quenching thin band, thickness t, and a cooling roller.
[0010] Q=wxtxV ... (I)
On the other hand, since a paddle tends to spread more that the wettability (only henceforth "wettability of a roll peripheral surface") to the molten metal of the peripheral surface of a cooling roller is good in latus area on the peripheral surface of a cooling roller, the width of face w of a quenching thin band becomes large, and if the wettability of a roll peripheral surface is bad, the width of face w of a quenching thin band will become small conversely.
[0011] Therefore, when a quenching thin band is manufactured having set the peripheral velocity V of a cooling roller, and the volumetric flow rate Q of a quenching thin band as constant, when the wettability of the above-mentioned formula (I) to a roll peripheral surface is good, width of face w is large, a small quenching thin band is obtained for thickness t, and if the wettability of a roll peripheral surface is conversely bad, width of face w will be small, a large quenching thin band will be obtained for thickness t, and it will become things.
[0012] And if thickness t of a quenching thin band is small, although heat transfer of the thickness direction is made for a short time and is advantageous to detailed-izing of crystal grain If thickness t of a quenching thin band is large, the heat transfer nature of the thickness direction is bad, the difference of the cooling rate of the roll side (field of the side in contact with the peripheral surface of a cooling roller) of a quenching thin band and a free side (field of the side which does not contact the peripheral surface of a cooling roller) will become large, and crystal grain will especially big-and-rough-become easy to turn into a free side side.
[0013] Since it was such, as a result of inquiring wholeheartedly paying attention to the wettability of a roll peripheral surface, by using the cooling roller which made wettability of a roll peripheral surface the predetermined range, this invention person could attain detailed-ization of crystal grain, found out that outstanding magnetic properties were obtained, and resulted in this invention.
[0014] That is, this invention is as being shown in following the (1) - (13).
[0015] (1) Inject the molten metal of magnet material from a nozzle, make it collide with the peripheral surface of the cooling roller which is rotating to the aforementioned nozzle, and carry out cooling solidification. The metallic material which is the manufacture method of magnet material of manufacturing a thin band-like magnet material, and constitutes the peripheral surface of the aforementioned cooling roller The manufacture method of the magnet material characterized by being that from which the contact angle with the aforementioned horizontal surface of the congelation to make becomes 70-170 degrees when the drop of the aforementioned molten metal is made to place and solidify on the horizontal surface of this metallic material.
[0016] (2) Inject the molten metal of magnet material from a nozzle in a controlled atmosphere, make it collide with the peripheral surface of the cooling roller which is rotating to the aforementioned nozzle, and carry out cooling solidification. The metallic material which is the manufacture method of magnet material of

manufacturing a thin band-like magnet material, and constitutes the peripheral surface of the aforementioned cooling roller The manufacture method of the magnet material characterized by being that from which the contact angle with the aforementioned horizontal surface of the congelation to make becomes 70-170 degrees when the drop of the aforementioned molten metal is made to place and solidify on the horizontal surface of the aforementioned metallic material in the aforementioned controlled atmosphere, a homotypic, and the gas of this **.
[0017] (3) The above (1) whose peripheral velocity of the aforementioned cooling roller is 1-60m/second, or the manufacture method of a magnet material given in (2).
[0018] (4) The above (1) whose maximum eccentricity of the cooling roller peripheral surface accompanying rotation of the aforementioned cooling roller is below the double precision of the average thickness of a thin band-like magnet material obtained, or the manufacture method of a magnet material given in either of (3).
[0019] (5) The aforementioned controlled atmosphere is the manufacture method of a magnet material the above (1) which is inert gas, or given in either of (4).
[0020] (6) The aforementioned magnet material is the manufacture method of a magnet material the above (1) which is an alloy containing R (however, at least one sort in the rare earth elements in which R contains Y), or given in either of (5).
[0021] (7) The aforementioned magnet material is the manufacture method of a magnet material the above (1) which is an alloy containing R (however, at least one sort in the rare earth elements in which R contains Y), and TM (however, TM, at least one sort in transition metals) and B, or given in either of (5).
[0022] (8) Thin band-like magnet material characterized by being manufactured by the manufacture method of a magnet material the above (1) or given in either of (7).
[0023] (9) Powdered magnet material characterized by having ground the magnet material of a publication to the above (8), and supposing that it is powdered.
[0024] (10) The bond magnet which combines a powdered magnet material of a publication with the above (9) by the joint resin, and is characterized by the bird clapper.
[0025] (11) A bond magnet given in the above (10) whose content of the magnet material of the shape of aforementioned powder is 82 - 99.5wt%.
[0026] (12) Coercive force iHc The above (10) which is 0.35 or more MA/m, or bond magnet given in (11).
[0027] (13) Magnetic-energy product (BH) max 50 kJ/m3 The above (10) which it is above, or bond magnet given in either of (12).
[0028]
[Embodiments of the Invention] Hereafter, the manufacture method, the magnet material, and the bond magnet of the magnet material of this invention are explained in detail, referring to an accompanying drawing.
[0029] The perspective diagram showing the example of composition of the equipment (quenching thin band manufacturing installation) to which drawing 1 manufactures the magnet material of this invention by the single rolling method, and drawing 2 are the cross-section side elevations showing the state near the collision part to the cooling roller of the molten metal in the equipment shown in drawing 1 .
[0030] As shown in drawing 1 , the quenching thin band manufacturing installation 1 is equipped with the barrel 2 which can contain magnet material, and the cooling roller 5 which rotates in the direction of arrow in drawing A to this barrel 2. The nozzle (orifice) 3 which injects the molten metal of magnet material is formed in the soffit of a barrel 2.
[0031] Moreover, by arranging the coil 4 for heating at an about three nozzle [of a barrel 2] periphery, and impressing a RF to this coil 4, the inside of a barrel 2 is heated (IH) and the magnet material in a barrel 2 is changed into a melting state.
[0032] The cooling roller 5 consists of a base 51 and a surface layer 52 which forms the peripheral surface 53 of a cooling roller 5.
[0033] The component of a base 51 may consist of the quality of the materials which may really consist of the same quality of the materials as a surface layer 52, and are different in a surface layer 52.
[0034] Although especially the component of a base 51 is not limited, it is desirable to consist of metallic materials with high thermal conductivity like copper or a copper system alloy so that the heat of a surface layer 52 can be radiated more quickly.
[0035] Moreover, as for a surface layer 52, it is desirable to consist of metallic materials which are described below.
[0036] Such a quenching thin band manufacturing installation 1 is installed in a chamber (not shown), and operates in the state where it filled up with the controlled atmosphere of inert gas or others preferably in this chamber. In order to prevent oxidization of the quenching thin band 8 especially, as for a controlled atmosphere, it is desirable that it is inert gas.
[0037] As inert gas, although argon gas, gaseous helium, nitrogen gas, etc. are mentioned, for example, especially gaseous helium is desirable. the dimple according to the contamination of a gas stream to the roll side 81 of the quenching thin band 8 when gaseous helium is used for the reason as a controlled atmosphere, especially area -- the huge 2000-micrometer two or more dimples 13 (the imaginary line in drawing 2 shows) -- being generated -- being hard -- it is because heat transfer nature improves and higher magnetic properties are obtained

[0038] When magnet ingredients are paid in a barrel 2, and it heats with a coil 4, it fuses in the quenching thin band manufacturing installation 1 and the molten metal 6 is injected from a nozzle 3, as shown in drawing 2 , a molten metal 6 It is cooled quickly, and solidifies, being dragged by the peripheral surface 53 of the rotating cooling roller 5, after colliding with the peripheral surface 53 of a cooling roller 5 and forming a paddle (cold slug well) 7, and the quenching thin band 8 is formed continuously or intermittently. Thus, soon, the roll side 81 separates from a peripheral surface 53, and the formed quenching thin band 8 runs in the direction of arrow B in drawing 1 . In addition, a dotted line shows the solidification interface 71 of a molten metal among drawing 2 .
[0039] Although the suitable range changes with wettability to composition of an alloy molten metal, and the molten metal 6 of a peripheral surface 53 etc., usually, as for the peripheral velocity V of a cooling roller 5, it is desirable that it is 1-60m/second, and it is more desirable that it is 5-40m/second. If the peripheral velocity of a cooling roller 5 is too slow, thickness t of the quenching thin band 8 will become thick with the volumetric flow rate Q of the quenching thin band 8 (refer to the aforementioned formula (I)), the diameter of crystal grain will increase, if the peripheral velocity V of a cooling roller 5 is too quick conversely, it will become amorphous and, in any case, magnetic properties will fall.
[0040] The metallic material which constitutes the peripheral surface 53 of a cooling roller 5, i.e., the metallic material which constitutes a surface layer 52, (henceforth "roll peripheral surface material") has the wettability (only henceforth "wettability") to the following molten metals 6, and it is constituted. That is, as shown in drawing 3 , a horizontal surface 10 is formed with the roll peripheral surface material 9, the drop of a molten metal 6 is placed on this horizontal surface 10, and when it is made to solidify, the contact angle theta with the horizontal surface 10 of the congelation 11 to make becomes 70-170 degrees. In this case, it is desirable that it is 80-165 degrees, as for a contact angle theta, it is more desirable that it is 90-160 degrees, and it is still more desirable that it is 95-150 degrees.
[0041] The wettability of the peripheral surface 53 of a cooling roller 5 is not measured directly, but a horizontal surface 10 is formed with the same material (roll peripheral surface material) as it here, and the wettability of this horizontal surface 10 is measured because it cannot stop and put the drop of a molten metal 6 on a fixed position but measurement of a contact angle is impossible or difficult for it, since a peripheral surface 53 is a curve convex.
[0042] In addition, in order to obtain more the correspondence relation with wettability of the peripheral surface 53 of the cooling roller 5 used for actual manufacture of a quenching thin band to accuracy on the occasion of measurement of a contact angle theta, it is desirable to perform solidification of the drop of a molten metal 6 in the aforementioned controlled atmosphere, a homotypic, and the gas of this **. Moreover, the volume of a congelation 11 is 3 0.005-0.1cm. Measuring in the range is desirable.
[0043] If a contact angle theta exceeds the upper limit of the above-mentioned range, the wettability of a peripheral surface 53 will be bad, and it will become the inclination for thickness t of the quenching thin band 8 to become thick with the volumetric flow rate Q of the quenching thin band 8, especially the crystal grain by the side of the free side 82 of the quenching thin band 8 will turn big and rough, and magnetic properties will fall. In addition, if a volumetric flow rate Q is made small also by this case, although thickness t also becomes thin (refer to the aforementioned formula (I)) and this fault is canceled or eased, since the fall of productivity is caused, it is not desirable.
[0044] Moreover, since the wettability of a peripheral surface 53 is too good in a contact angle theta being under the lower limit of the above-mentioned range, a paddle 7 spreads too much, therefore the configuration of the quenching thin band 8 and a size (width of face w, thickness t) become unstable, and the uniform and homogeneous quenching thin band 8 is not obtained (variation arises in a state, magnetic properties, etc. of crystal grain).
[0045] In addition, on the occasion of measurement of a contact angle theta, the ablation (coming floating) 12 as shown in drawing 4 may arise by the solidification shrinkage near the solidification interface the drop of a molten metal 6 contacts a horizontal surface 10. In this case, the portion which ablation 12 produced is excepted and a contact angle theta is measured. Namely, a contact angle theta is measured by using as datum level field 10' parallel to the horizontal surface 10 which passes along the upper limit (peak) of ablation 12.
[0046] By the way, in the quenching thin band manufacturing installation 1, a cooling roller 5 faces rotating, and as shown in drawing 5 , some eccentricity (axial deflection) arises from the dimensional accuracy (roundness) of cooling roller 5 the very thing, the installation precision over the bearing of a cooling roller 5, etc.
[0047] If this eccentricity is large, the front face and the solidification interface 71 of a melting alloy in a paddle 7 vibrate, change will arise in the size (width of face w, thickness t) of the obtained quenching thin band 8, or change will arise at the time when the roll side 81 of the quenching thin band 8 touches the peripheral surface 53 of a cooling roller 5. Furthermore, the incidence rate of the aforementioned huge dimple 13 also increases. Consequently, the cooling rate of the quenching thin band 8 etc. is changed, and variation arises in magnetic properties. And magnetic properties fall [the bond magnet using the magnet powder or it which were obtained from such a quenching thin band 8].
[0048] In order to prevent such a thing, it is desirable to make maximum eccentricity deltaR (to refer to drawing 5) of the peripheral surface 53 of the cooling roller 5 accompanying rotation of a cooling roller 5 below into the double precision of thickness (average) t of the quenching thin band 8 which can be obtained by this

invention, considering as 1.5 or less times is more desirable, and considering as 1 or less time is still more desirable. Thereby, the magnetic properties of the obtained quenching thin band 8 can be made more into homogeneity. And the magnetic properties of the bond magnet manufactured from this can be raised. Especially in this invention, further excellent magnetic properties can be demonstrated according to the synergistic effect of specifying such maximum eccentricity deltaR and specifying the wettability of the peripheral surface 53 mentioned above.
[0049] Here, especially the lower limit of maximum eccentricity deltaR is the limitation of the precision of the bearing which supports the limitation of the process tolerance of the peripheral surface 53 of a cooling roller 5, and a cooling roller 5 although not limited to 0.1 micrometers. It can consider as a grade.
[0050] In addition, maximum eccentricity deltaR can be measured with precision sizer vessels, such as for example, a laser displacement gage, an electrostatic displacement gage, and a precision gage.
[0051] As a magnet material in this invention, it is R (however, R). The alloy containing at least one sort in the rare earth elements containing Y, especially R (however, R) Rare earth permanent magnet material like the alloy containing at least one sort in the rare earth elements containing Y, and TM (however, TM, at least one sort in transition metals) and B is mentioned, and the thing of composition of following [1] - [4] is desirable.
[0052] [1] What makes a fundamental component the rare earth elements which are mainly concerned with Sm, and the transition metals which are mainly concerned with Co (henceforth a Sm-Co system alloy).
[0053] [2] What makes a fundamental component the transition metals which are mainly concerned with R (however, at least one sort in the rare earth elements in which R contains Y), and Fe, and B (henceforth a R-Fe-B system alloy).
[0054] [3] What makes a fundamental component the rare earth elements which are mainly concerned with Sm, the transition metals which are mainly concerned with Fe, and the element between grids which is mainly concerned with N (henceforth an Sm-Fe-N system alloy).
[4] What makes a fundamental component transition metals, such as R (at least one sort however, among the rare earth elements in which R contains Y), and Fe, and has a magnetic phase on nano meter level (nano crystal magnet).
[0055] As a typical thing of a Sm-Co system alloy, $SmCo_5$ and Sm_2TM_{17} (however, TM, transition metals) are mentioned.
[0056] As a typical thing of a R-Fe-B system alloy, a Nd-Fe-B system alloy, a Pr-Fe-B system alloy, a Nd-Pr-Fe-B system alloy, a Ce-Nd-Fe-B system alloy, a Ce-Pr-Nd-Fe-B system alloy, the thing that replaced a part of Fe in these by other transition metals, such as Co and nickel, are mentioned.
[0057] It is $Sm_2Fe_{17}N_3$ which nitrided and produced Sm_2Fe_{17} alloy as a typical thing of an Sm-Fe-N system alloy. It is mentioned.
[0058] as the aforementioned rare earth elements, Y, La, Ce, Pr, Nd, Pm, Sm, Eu, Gd, Tb, Dy, Ho, Er, Tm, Yb, Lu, and a misch metal mention -- having -- these -- one sort -- or two or more sorts can be included moreover, Fe, Co, nickel, etc. mention as the aforementioned transition metals -- having -- these -- one sort -- or two or more sorts can be included Moreover, in order to raise magnetic properties, in magnet material, B, aluminum, Cu, Ga Si, Ti, V, Ta, Zr, Nb, Mo, Hf, Ag, Zn, P, germanium, etc. can also be contained if needed.
[0059] The magnetic properties in which the quenching thin band (thin band-like magnet material) 8 of this invention obtained by the above manufacture methods turned minutely, consequently crystal grain was excellent are obtained.
[0060] Moreover, a powdered magnet material (magnet powder) of this invention is obtained by grinding such a quenching thin band 8.
[0061] Especially the method of trituration is not limited, for example, can be performed using various trituration equipments, such as a ball mill, a vibration mill, a jet mill, and a pin mill, and a shredding equipment. In this case, trituration can also be performed in a non-oxidizing atmosphere like [under a vacuum or a reduced pressure state (for example, $1x10^{-1}$ - $1x10^{-6}$ Torr) or in inert gas, such as nitrogen gas argon gas, and gaseous helium,], in order to prevent oxidization.
[0062] A different thing only not only in the thing of the same composition which mixed the magnet powder of two or more sorts of composition is sufficient as such magnet powder. For example, what mixed at least two sorts in the thing of composition of aforementioned [1] - [4] is mentioned. In this case, it can have the advantage of each magnet powder to mix simulataneously, and more excellent magnetic properties can be obtained easily.
[0063] Moreover, in the case of the thing for manufacturing the bond magnet mentioned later, although not limited, especially the mean particle diameter of magnet powder is 0.5-60 micrometers. A grade is desirable and it is 1-40 micrometers. A grade is more desirable. moreover, in order to obtain the good moldability at the time of fabrication by a small amount of joint resin which is mentioned later, the particle size distribution of magnet powder is distributed to some extent -- ****'s (there is variation) -- it is desirable The rate of a hole of the obtained bond magnet can be reduced by this, the mechanical strength of a bond magnet can be raised more, and magnetic properties can be improved further.
[0064] In addition, the mean particle diameters may differ for every composition of different magnet powder case [powder] and mixed although the magnet powder of two or more sorts of composition was mixed. Moreover, what is necessary is to just be manufactured by the method of a different this invention which at least one sort in the magnet powder of two or more sorts of composition mentioned above the case in the end of

such mixed powder.

[0065] When a bond magnet is manufactured using the above magnet powder, such magnet powder has good unity (wettability of a joint resin) with a joint resin, therefore this bond magnet has a high mechanical strength and it becomes the thing excellent in thermal stability (thermal resistance) and corrosion resistance. Therefore, the magnet powder concerned fits manufacture of a bond magnet.

[0066] In addition, the magnet powder (powdered magnet material) of this invention cannot be overemphasized by that you may be what it is not limited to what is used for manufacture of a bond magnet, for example, is used for manufacture of a sintered magnet.

[0067] Next, the bond magnet of this invention is explained.

[0068] The bond magnet of this invention comes to join the above-mentioned magnet powder together by the joint resin.

[0069] As a joint resin (binder), any of thermoplastics and thermosetting resin are sufficient.

[0070] As thermoplastics, for example A polyamide (example : nylon 6, Nylon 46, Nylon 66, Nylon 610, Nylon 612, Nylon 11, Nylon 12, Nylon 612, nylon 6 -66), Liquid crystal polymers, such as a thermoplastic polyimide and an aromatic polyester, a polyphenylene oxide, Polyolefines, such as polyphenylene sulfide, polyethylene, polypropylene, and an ethylene vinylacetate copolymer, A denaturation polyolefine, a polycarbonate, a polymethylmethacrylate, Polyester, such as a polyethylene terephthalate and a polybutylene terephthalate, The copolymer which is mainly concerned with these, a blend object, a polymer alloy, etc. are mentioned, and a polyether, a polyether ether ketone, polyether imide, a polyacetal, etc. can mix and use 1 of sorts of these, and two sorts or more.

[0071] Also among these, especially the moldability is excellent, and since the mechanical strength is high, that which is mainly concerned with a liquid crystal polymer and polyphenylene sulfide from the point of a polyamide and heat-resistant improvement is desirable. Moreover, these thermoplastics is excellent also in kneading nature with magnet powder.

[0072] Such thermoplastics has the advantage that selection wide range like what thought the moldability as important, and the thing which thought thermal resistance and the mechanical strength as important is attained by the kind, copolymerization-ization, etc.

[0073] On the other hand, as thermosetting resin, various epoxy resins, such as a bisphenol type, a novolak type and a naphthalene system, phenol resin, a urea resin, melamine resin, a polyester (unsaturated polyester) resin polyimide resin, silicone resin, a polyurethane resin, etc. are mentioned, and 1 of sorts of these and two sorts or more can be mixed and used, for example.

[0074] From the point of especially the moldability being excellent also among these, and a mechanical strength being high and excelling in thermal resistance, an epoxy resin, phenol resin, polyimide resin, and silicone resin are desirable, and especially an epoxy resin is desirable. Moreover, these thermosetting resin is excellent also in kneading nature with magnet powder, and the homogeneity of kneading.

[0075] In addition, the thing of a solid [thing / liquefied] (powdered) is sufficient as the thermosetting resin (un-hardening) used at a room temperature.

[0076] Such a bond magnet of this invention is manufactured as follows, for example. Magnet powder, a joint resin, and the constituent for bond magnets (compound) that contains additives (an antioxidant, lubricant, etc.) if needed are manufactured, and it fabricates in a desired magnet configuration all over a magnetic field or a non-magnetic field by methods, such as compression molding, extrusion molding, and injection molding, using this constituent for bond magnets. When a joint resin is thermosetting resin, it is hardened by heating etc. after fabrication.

[0077] As for the content of the magnet powder in a bond magnet, it is desirable that it is about 82-99.5wt%, and it is more desirable that it is about 90-99wt%. Although the bond magnet was especially manufactured by compression molding, as for the content of magnet powder, to a case, it is desirable that it is about 93-99.5wt%, and it is more desirable to it that it is about 95-99wt%.

[0078] If improvement in magnetic properties (especially magnetic-energy product) cannot be aimed at if there are too few contents of magnet powder, and there are too many contents of magnet powder, joint resins content will decrease relatively and a moldability will fall.

[0079] Such a bond magnet of this invention demonstrates outstanding magnetic properties from the property of the quenching thin band 8 used as the raw material mentioned above, the numerousness of the manufacture conditions of a bond magnet, and the contents of the magnet powder contained in a bond magnet, etc.

[0080] That is, the bond magnet of this invention is coercive force iHc. 0.35 or more MA/m is 0.50 or more MA/m more preferably.

[0081] The bond magnet of this invention, especially the bond magnet fabricated all over the non-magnetic field are magnetic-energy (product BH) max. It is 50 kJ/m3 preferably. It is 70 kJ/m3 more preferably above. It is above.

[0082] It is not limited, for example, about a configuration, the thing of all configurations, such as the shape of the shape of a pillar, a prismatic, and a cylinder (the shape of a ring), circular, plate-like, and a curve tabular, is possible for the configuration of the bond magnet of this invention, especially a size, etc., for example, and the thing of all sizes is possible for them from a thing also with the large-sized size to a micro thing.

EXAMPLE

[Example] Hereafter, the concrete example of this invention is explained.
[0084] (Example 1) The hardener ingot as which alloy composition is expressed in Nd10Pr2.5 Febal.Co6 aluminum3 Cu1.5 Nb1 Ga1 B5 (composition A) was cast. About 15g sample was started from this ingot.
[0085] The quenching thin band manufacturing installation 1 of composition of being shown in drawing 1 was prepared, and the aforementioned sample was put in in the quartz tube which prepared the nozzle (circular hole orifice) in the pars basilaris ossis occipitalis. After deaerating the inside of the chamber by which the quenching thin band manufacturing installation 1 is contained, gaseous helium was introduced as a controlled atmosphere and it considered as the temperature of 21 degrees C, and the controlled atmosphere of pressure 60KPa.
[0086] Then, the ingot sample in a quartz tube was fused by high-frequency induction heating, this molten metal was injected by the differential pressure of the internal pressure of a quartz tube, and an ambient pressure towards the peripheral surface of the cooling roller with a diameter [of 200mm], and a width of face of 20mm which rotates by 1500rpm (peripheral velocity : 15.7m/(second)), and the quenching thin band of the alloy of the aforementioned composition A was obtained.
[0087] The surface layer (roll peripheral surface) of a cooling roller should consist of Pd-8wt%Ru-2wt%Pt alloys. Moreover, thickness of this surface layer was set to 5mm.
[0088] It was 95 degrees when the contact angle theta of the aforementioned congelation was measured by the method which forms a horizontal surface with the component and this material of this surface layer, trickles the molten metal of the aforementioned composition A calmly, is made to solidify it on the aforementioned horizontal surface in the gas of the aforementioned controlled atmosphere and these conditions, obtains a congelation (volume 0.01cm3), and is shown in drawing 3 or drawing 4 . In addition, measurement of a contact angle theta was optically performed using the projector.
[0089] moreover, the place which measured maximum eccentricity deltaR of the cooling roller peripheral surface by rotation of a cooling roller by the laser displacement gage -- deltaR=10micrometer it was .
[0090] (Example 2) The quenching thin band was manufactured like the example 1 except having constituted the surface layer (roll peripheral surface) of a cooling roller from a nickel-10wt%Ti-10wt%aluminum-5wt%Mo alloy.
[0091] It was 150 degrees, when the horizontal surface was formed with the component and this material of this surface layer, the molten metal of the aforementioned composition A is dropped calmly, was made to solidify on the aforementioned horizontal surface in the gas of the aforementioned controlled atmosphere and these conditions, the congelation (volume 0.01cm3) was obtained and the contact angle theta of the aforementioned congelation was measured by the same method as an example 1.
[0092] moreover, the place which measured maximum eccentricity deltaR of the cooling roller peripheral surface by rotation of a cooling roller by the laser displacement gage -- deltaR=12micrometer it was .
[0093] (Example 3) While manufacturing a quenching thin band from the molten metal of this composition which used the ingot which consists of Nd11Ce2 Sm1 Febal.Co4 Cu1.5 Ga1 Ti0.5 B6 (composition B) The quenching thin band was manufactured like the example 1 except having constituted the surface layer (roll peripheral surface) of a cooling roller from a W-20wt%Zr-3wt%Nb alloy.
[0094] It was 70 degrees, when the horizontal surface was formed with the component and this material of this surface layer, the molten metal of the aforementioned composition B is dropped calmly, was made to solidify on the aforementioned horizontal surface in the gas of the aforementioned controlled atmosphere and these conditions, the congelation (volume 0.01cm3) was obtained and the contact angle theta of the aforementioned congelation was measured by the same method as an example 1.
[0095] moreover, the place which measured maximum eccentricity deltaR of the cooling roller peripheral surface by rotation of a cooling roller by the laser displacement gage -- deltaR=9micrometer it was .
[0096] About each quenching thin band of the <characterization of quenching thin band> examples 1-3, the width of face w and thickness t were measured. This measurement was measured by 20 point of measurement per quenching thin band by the microscope, and was made into the value which averaged this, respectively.
[0097] Next, while measuring the diameter of average crystal grain from the organization observation result by transverse electromagnetic about each quenching thin band, magnetic properties (coercive force iHc and magnetic-energy (product BH) max) were measured by VSM.
[0098] These measurement results are shown in the following table 1.
[0099] In addition, there was very little variation by the measurement part (less than **5% of averages), and each size (width of face w, thickness t) of each quenching thin band had high dimensional stability.
[0100] Moreover, when the rate of area which observes a roll side with a scanning electron microscope (SEM), and performs image analysis further about each quenching thin band, and the with a 2000-micrometer area [or more 2] huge dimple to a roll side occupies from this analysis result was investigated, all were low values very much.
[0101]
[Table 1]

急冷薄帯の特性

	接触角 θ	急冷薄帯の幅w (mm)	急冷薄帯の厚さt (μm)	平均結晶粒径 (nm)	iHc (MA/m)	(BH) max (kJ/m³)
実施例1	95°	1. 1	26. 7	25	0. 69	112
実施例2	150°	0. 8	30. 9	29	0. 64	104
実施例3	70°	1. 4	24. 5	23	0. 95	92

[0102] As shown in Table 1, each quenching thin band of this invention of examples 1-3 can attain detailed-ization of crystal grain, and high magnetic properties are obtained.
[0103] (Example 4) A grinder (RAIKAI machine) grinds the quenching thin band of an example 1 in inert gas, and a mean particle diameter is 16 micrometers. It considered as magnet powder, this magnet powder, epoxy resin 2.0wt%, hydrazine system antioxidant 0.15wt%, and stearate (lubricant) 0.05wt% were mixed, this mixture was fully kneaded (120 degree-Cx 10 minutes), and the constituent for bond magnets (compound) was produced.
[0104] subsequently -- grinding this compound and being granular -- carrying out -- this granular object -- weighing capacity -- carrying out -- the metal mold of press equipment -- inside -- being filled up -- 130 degrees C of material temperature, and pressure 6 ton/cm2 It pressed (inside of a non-magnetic field), and the Plastic solid was obtained. Heat hardening of the epoxy resin was carried out after mold release, and the pillar-like bond magnet with a diameter [of 10mm] x height of 7mm was obtained.
[0105] (Example 5) A grinder (RAIKAI machine) grinds the quenching thin band of an example 2 in inert gas, and a mean particle diameter is 20 micrometers. It considered as magnet powder, this magnet powder, epoxy resin 2.5wt%, hydrazine system antioxidant 0.1wt%, and stearate (lubricant) 0.1wt% were mixed, this mixture was fully kneaded (120 degree-Cx 10 minutes), and the constituent for bond magnets (compound) was produced
[0106] subsequently -- grinding this compound and being granular -- carrying out -- this granular object -- weighing capacity -- carrying out -- the metal mold of press equipment -- inside -- being filled up -- 130 degrees C of material temperature, and pressure 6 ton/cm2 It pressed (inside of a non-magnetic field), and the Plastic solid was obtained. Heat hardening of the epoxy resin was carried out after mold release, and the pillar-like bond magnet with a diameter [of 10mm] x height of 7mm was obtained.
[0107] (Example 6) A grinder (RAIKAI machine) grinds the quenching thin band of an example 3 in inert gas, and a mean particle diameter is 18 micrometers. It considered as magnet powder, this magnet powder, epoxy resin 1.9wt%, hydrazine system antioxidant 0.1wt%, and stearate (lubricant) 0.05wt% were mixed, this mixture was fully kneaded (120 degree-Cx 10 minutes), and the constituent for bond magnets (compound) was produced.
[0108] subsequently -- grinding this compound and being granular -- carrying out -- this granular object -- weighing capacity -- carrying out -- the metal mold of press equipment -- inside -- being filled up -- 130 degrees C of material temperature, and pressure 6 ton/cm2 It pressed (inside of a non-magnetic field), and the Plastic solid was obtained. Heat hardening of the epoxy resin was carried out after mold release, and the pillar-like bond magnet with a diameter [of 10mm] x height of 7mm was obtained.
[0109] (Example 7) The magnet powder obtained in the example 4 and the magnet powder obtained in the example 6 were uniformly mixed by the weight ratio 6:4, and mixed magnet powder was obtained. This mixed magnet powder, epoxy resin 2.0wt%, hydrazine system antioxidant 0.15wt%, and stearate (lubricant) 0.05wt% were mixed, this mixture was fully kneaded (120 degree-Cx 10 minutes), and the constituent for bond magnets (compound) was produced.
[0110] subsequently -- grinding this compound and being granular -- carrying out -- this granular object -- weighing capacity -- carrying out -- the metal mold of press equipment -- inside -- being filled up -- 130 degrees C of material temperature, and pressure 6 ton/cm2 It pressed (inside of a non-magnetic field), and the Plastic solid was obtained. Heat hardening of the epoxy resin was carried out after mold release, and the pillar-like bond magnet with a diameter [of 10mm] x height of 7mm was obtained.
[0111] (Example 8) The magnet powder obtained in the example 4, the magnet powder obtained in the example 5, and the magnet powder obtained in the example 6 were uniformly mixed by the weight ratio 2:3:5, and mixed magnet powder was obtained. This mixed magnet powder, epoxy resin 1.8wt%, hydrazine system antioxidant 0.2wt%, and stearin acid (lubricant) 0.1wt% were mixed, this mixture was fully kneaded (120 degree-Cx 10 minutes), and the constituent for bond magnets (compound) was produced.
[0112] subsequently -- grinding this compound and being granular -- carrying out -- this granular object --

weighing capacity -- carrying out -- the metal mold of press equipment -- inside -- being filled up -- 130 degrees C of material temperature, and pressure 6 ton/cm2 It pressed (inside of a non-magnetic field), and the Plastic solid was obtained. Heat hardening of the epoxy resin was carried out after mold release, and the pillar-like bond magnet with a diameter [of 10mm] x height of 7mm was obtained.
[0113] About each bond magnet of the <characterization of bond magnet> examples 4-8, the magnetic properties (coercive force iHc and magnetic-energy (product BH) max) were measured in maximum impression magnetic field 2 MA/m with the account fluxmeter of ******.
[0114] furthermore -- these bond magnets -- 60 degree-Cx95%RH -- the constant temperature by 500 hours -- the constant humidity examination was performed and corrosion resistance was investigated This corrosion resistance distinguished the existence of generating of the rust in a bond magnet front face by viewing, and evaluated as a x mark what ** mark and generating of rust were notably accepted in in what O mark and generating of rust were accepted in a little in the thing without generating of rust.
[0115] These measurement results are shown in the following table 2. Moreover, the content (in the case of mixed magnet powder, it is the total amount) of the magnet powder in each bond magnet is collectively described all over the following table 2.
[0116]
[Table 2]

ボンド磁石の特性

	用いた磁石粉末	ボンド磁石中の磁石粉末含有量 (wt%)	iHc (MA/m)	(BH) max (kJ/m^3)	耐食性
実施例4	実施例1	97.9	0.67	73.5	○
実施例5	実施例2	97.4	0.62	70.6	△~○
実施例6	実施例3	98.0	0.94	62.9	○
実施例7	実施例1、3の混合 (=6:4)	97.9	0.84	70.4	○
実施例8	実施例1、2、3の混合 (=2:3:5)	98.1	0.90	68.5	○

[0117] As shown in Table 2, each bond magnet of this invention of examples 4-8 is more than coercive force iHc 0.35 MA/m and magnetic-energy (product BH) max. 50 kJ/m3 Corrosion resistance is also excellent while having the magnetic properties which were excellent with the above.
[0118] Especially, more excellent magnetic properties are obtained in the examples 7 and 8 using mixed magnet powder.

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] It is the perspective diagram showing the example of composition of the equipment (quenching thin band manufacturing installation) which manufactures the magnet material of this invention.
[Drawing 2] It is the cross-section side elevation showing the state near the collision part to the cooling roller of the molten metal in the equipment shown in drawing 1 .
[Drawing 3] It is the cross-section side elevation showing the wettability measuring method for the molten metal of a cooling roller peripheral surface.
[Drawing 4] It is the cross-section side elevation showing the wettability measuring method for the molten metal of a cooling roller peripheral surface.
[Drawing 5] It is the side elevation showing the maximum eccentricity of the cooling roller peripheral surface accompanying rotation of a cooling roller.
[Description of Notations]
1 Quenching Thin Band Manufacturing Installation
2 Barrel
3 Nozzle
4 Coil
5 Cooling Roller
51 Base

52 Surface Layer
53 Peripheral Surface
6 Molten Metal
7 Paddle
71 Solidification Interface
8 Quenching Thin Band
81 Roll Side
82 Free Side
9 Roll Peripheral Surface Material
10 Horizontal Surface
10' Field
11 Congelation
12 Ablation
13 Huge Dimple